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Variability In Household's Mean Income Along The Kenya's Lake Victoria Ecosystem

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Abstract
One of the ways of minimizing rural urban migration and subsequent population explosion in the urban centers is to create income earning opportunities in the rural areas. One of the valuable resources in Kenya is the Lake Victoria ecosystem which is predominantly rural. This research sought to determine existence of significant differences in mean income per household along the Lake Victoria ecosystem. The ecosystem was clustered in Counties with known administrative boundaries. These counties were Busia, Siaya, Kisumu, HomaBay and Migori. The sources of income that were identified included fishing, crop farming, livestock farming, sand harvesting, transport, tourism and trade. Three stages purposive sampling technique was used. Skillfully structured questionnaires of both open and closed ended questions were administered during the collection of data of sample size 394. Direct valuation method was used to calculate the mean income generated associated with various economic activities per household. Single factor ANOVA technique was used to determine if there exist significant differences in mean income per household across the counties. The data collected was subjected to analysis via the Statistical Package for Social Scientists (SPSS). The results obtained shows that there exists statistical significant mean differences in income between Busia and Migori, Busia and Homa Bay, HomaBay and Kisumu, Migori and Kisumu, HomaBay and Siaya and Migori and Siaya. Households in Migori and HomaBay earn higher mean income compared to their counterparts.

Keywords: *Mean income, Single factor, Anova, Direct Valuation*

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I. Introduction And Background Of The Study

Lake Victoria is well known to be the second largest fresh water lake in the world covering a surface area of 59,947 km^2, (Stuart and Hamilton 2018). Lake Victoria covers across three countries in East Africa namely Kenya, Uganda and Tanzania. Tanzania claims the biggest share of Lake Victoria (49%), followed by Uganda with 45% share of the lake. Kenya has only 6% claim to the lake which is a paltry share of the lake compared to her neighbors. Lake Victoria shoreline runs to a length of 7,142km with islands within the lake contributing 3.7% to the length of the shoreline. The Kenyan side of the Lake Victoria experiences an inland equatorial type of climate, (USAID 2011). The rainfall pattern is bimodal with rains received in mid-February to May and July to October. The average rainfall received per annum is between 500-1,000mm per annum.Temperatures around Lake Victoria vary with altitude rising from 21° C to 22.50° C in the high-altitude areas while in low altitude areas it ranges from 16.3° C to 29.1° C. The evaporationmean falls between 1,800mm to 2,200mm per year within the region. Projections show that by the early 2040's temperature may increase by 0.4ºC, with the first wet season projected to increase by 0.5% in the first wet season and 3% in the second.

In Kenya, Lake Victoria cuts across four Counties of Siaya, Busia, Kisumu, Homa Bay and Migori.The main economic activities around Lake Victoria include fishing, farming, transport, tourism, sand harvesting and trade. The neighborhood around the lake is mostly rural set ups with limited formal employment a part from residents serving in the public service. A number of studies have been done around the Lake Victoria Ecosystem Basin and also on variability on household income. Some of these studies have been used to help form the basis for this research.Kangalawe, Limenga, Kabumbuli and Walingo (2008) carried out a study on livelihood diversification and implications on poverty and environment in the Lake Victoria Basin. The study looked at how the rapidly changing social, economic and environmental conditions contributes to diversification of livelihood land use changes in the Lake basin. The results obtained showed that fishing is the main activity

around the Lake Victoria Basin. The findings further noted that decreasing trends in the availability of land over time is attributed mainly to livelihood diversification and the ever increasing population pressure.

Fiorella et al (2014), did a study on the analysis of links between fishing and food security around Lake Victoria, Kenya. The research examined if fishing households consumed more fish and if their food security was higher than the non-fishing households around Lake Victoria. The results showed that there was no significant association between fishing as a source of livelihood and food security or household fish consumption. Households with higher income consumed more fish than those with low income. The results further showed that household food security was highly associated with higherassets index scores and incomes.

Muyanga (2014) analyzed rural households' income poverty incidence over a period of time. The results obtained showed that there existgreat disparities in the regional welfare and dynamics over time in rural Kenya. The factors that were found to significantly impact on rural households' income included geographical locations and demographic factors (household dependency, burdens, gender and the level of education).Munga (2015) did research on evolution and decomposition of income inequality in Kenya. The study looked at the origin of income inequality in Kenya and gave a breakdown of the inequalities. The research found out that income inequality is sensitive to the part of the income distributions given more weight. The research further noted that there is no correspondence in the changes in inequality over time between urban and rural regions.Juma, Wegulo and Otieno (2017) carried out a study to assess the relationship between the land use and rural poverty among households in Muhoroni and Nyando Sub Counties. The results of the research showed that maize was the most dominant crop and that there was a significant relationship between land use and rural poverty in the mentioned sub counties.

Egde et al (2017) carried out a study to construct a wealth index to understand the trends of wealth and determine the predictors of wealth change index in Kenya. The study used thehealth surveyand demographic data. The results showed an increase in wealth between 1993 and 2008 in Kenya. However,there was no significant difference in the wealth increase between the rural and urban areas that was recorded. The strongest predictor was education; those with higher education levels had a higher standard deviation difference than those with no education. Households head who were women and those who had partners had less wealth in rural areas compared to their counterparts in the urban areas.

Ymeri, Musliu and Shkodra (2020) did a study to determine income distribution inequality and factors contributing to rural households' poverty. Results showed that the middle-income households possessed the highest potential in finding alternative employment in the non-farm sectors. The family size, number of family members above the age of 18, years of formal education and total income were seen to have had a positive impact on non-farm revenues. The poorest rural household had the highest share of income from farm activities. Nonfarm revenues have a positive impact on poverty alleviation. The study suggested adoption of suitable and sustainable policies to enhance non-farm employment for vulnerable households in rural areas.

Sassi et al (2021) applied the extended decomposition of Gini to examine household seasonal food expenditure inequality along the Lake Naivasha Basin. This research found that inequality reduces during the harvesting period of various food categories. The results further showed that there should be structured set of policies on poverty, food security and agriculture. This will contribute to the overall growth of the economy and achievement of the vision 2030.

Muyonga et al (2021) extended the application of spatial regression in determining the existence of relationship between inequality and migration.The county data was used in the study as it considered migration intensity as the response variable. The explanatory variables were access to clean water, access to consistent electricity, county Gini and composite index of county human development index. The results obtained showed that the income inequality within households had a nonlinear relationship with migration.Iraoya and Isinika (2022) examined the relationship between diversification and intensification of rural households in Nigeria using Panel data models. The results obtained showed that income diversification is increasing among Nigerian rural households. The study recommended a policy measure that households should not be encouraged to diversify their income but should also transmit productivity gains from diversification into agricultural intensification for the betterment of the rural economy.

This research sought to determine the existence of significant differences in mean income per household across the five counties. The research first computed the mean income per household per county using the direct valuation method.Little research has been down to determine the disparities in household mean income among the residents bordering Lake Victoria across the five counties. The results of this research will enable the policy makers and the local authorities to assess if the resources of the lake are fully exploited. It may also help address the challenge of rural urban migration which has given rise to the emergence of slums in most urban centers in Kenya.

II. Materials And Methods

Design

The approach employed in this study was a cross sectional study design. Data was collected at point in time and there was no room given for manipulation. Cross sectional study design allows the researcher to study many variables at ago.

Study Population and sampling procedure

Three stages purposive sampling technique was used. The first phase was to purposively pick the five counties that border Lake Victoria. These counties include Busia, Siaya, Kisumu, Homa Bay and Migori. A sample size per county was picked based on the length of the shoreline running across the county and the population size of the county (2019 Kenya Population Census). Using the nature of the economic activities around the beaches, purposive sampling was used to pick beaches from each county. Finally the subjects were picked at random from the selected beaches keeping a uniform distance between any two subjects.

Using the formulae given by equation 1, a sample size of 369 was obtained. However, to take care of none response 25 additional subjects were conveniently added bringing total sample size to 394. The sample size was obtained as

$$n = \frac{z^2 p(1-p)}{e^2\left(1+\frac{z^2 p(1-p)}{e^2 N}\right)} \quad (1)$$

Where: confidence level (α) of 95% with z = 1.96, p = proportion (expressed as a decimal), N = population size and e = margin of error was adopted.

Well-structured questionnaires were administered in the data collection process with the aid of Kobocollect toolkit where data was collected electronically.

Household Income

Calculating the mean household income was done using the value of the gross output. This is a technique for determining the economic activity occurring in natural environment. It is mostly used because of its ability to accurately measure the household likelihoods (Lwesya 2004). The key indicators that were used to assess the gross output value were crop production, catches of fish, livestock production and self-empowerment. Crop production was considered was considered as the market value of all agricultural products. Catches of fish was measured in terms of the total annual catch of biomass and the average price of the catch per kilogram. Livestock production was calculated as per the market value of stock activities within and outside the farm. Self-employment was calculated as the gross income

Equation 2 defines the model that was used to measure t the income.

$$TL_{i\&r} = \Sigma_{i=1}^{n}[C_i P_i - (k_i)] \quad (2)$$

where TLi&r - total income Ci - yield of ithproduct, Pi - market price of theithproduct and Ki - production costs for ith product

Single FactorAnalysis of Variance

To determine existence of significant differences in the mean income of households across the five counties, single factor analysis of variance was used. Using analysis of variance with a single factor the following null hypothesis was tested;

$$H_0; \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

The alternative hypothesis was that there is significant difference in at least a single pair of means.

Wherever the null hypothesis is rejected, post ANOVA test was done using Tukey's HSD test to determine which specific pair of counties has significant mean differences in household income.

III. Results and Discussions

The sources of income were mainly fishing, crop farming, livestock farming and none farming/fishing activities

Income from Fishing

Incoming from fishing comprised monies earned through sale of fish, sale of fishing gear and fishing craft and employment in fishing activities. The total amount of income earned from fishing related kind of activities in the past one year was found to be Kshs. 101,437,100. Mean annual income from fishing related kind of activities was found to be Kshs. 400, 937 per household involved in fishing. The bulk of this income came from Migori

county which had a mean income of Kshs. 867,333 followed by Homa Bay County with a mean income of Kshs. 630,992. A summary of the total fishing income distribution per County is given by figure 1 and Table 1.

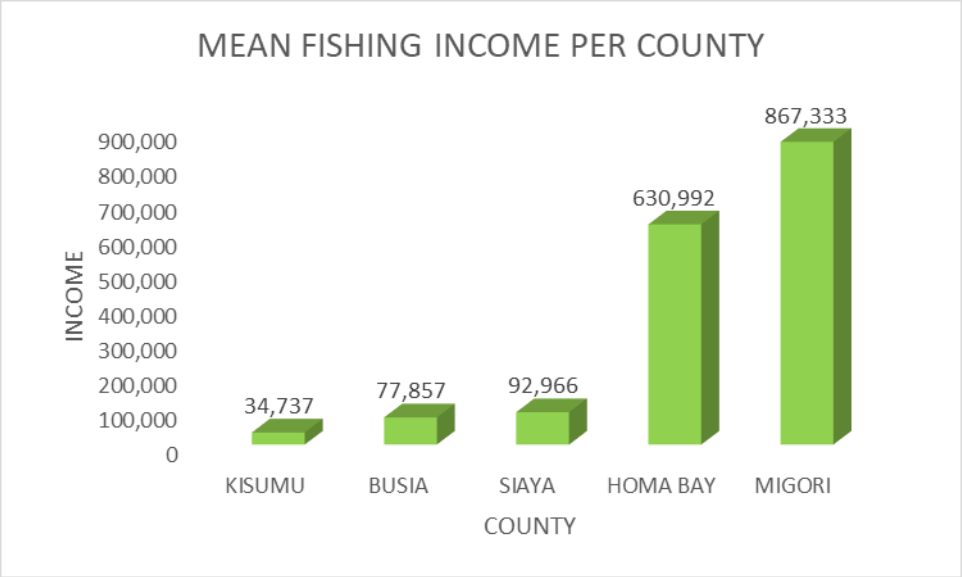

***Figure 1.*The Annual Fishing Income**

Table 1
Annual Income from Fishing Related activities (Kshs)

County	Statistics	Sale of Fish	Sale of Fishing Gear and Fishing Craft	Casual Employment in Fishing Activities	Fishing Total
Busia	Mean	56,667	40,000	41,667	77,857
	Total	340,000	80,000	125,000	545,000
Homa Bay	Mean	628,376	160,696	101,500	630,992
	Total	65,351,100	3,696,000	1,624,000	70,671,100
Kisumu	Mean	24,544	83,571	18,630	34,737
	Total	1,104,500	585,000	186,300	1,875,800
Migori	Mean	873,750	575,000	49,333	867,333
	Total	20,970,000	2,300,000	148,000	23,418,000
Siaya	Mean	89,113	58,250	51,714	92,966
	Total	4,099,200	466,000	362,000	4,927,200
Grand Total	Mean	408,288	161,977	62,700	400,937
	Total	91,864,800	7,127,000	2,445,300	101,437,100

A deeper interrogation of Table 1 reveal that Migori County had the highest mean annual income in sale of fish (Kshs. 873,750) and sale fishing gear and crafts (Kshs. 575,000). Homa Bay was the second highest in mean income from sale of fish (Kshs. 628,376) and sale of fishing materials (Kshs. 160,696). In terms of mean annual income from fishing related employment Homa Bay had the highest (Kshs. 101,500). A pictorial representation of the same is given by figure 2.

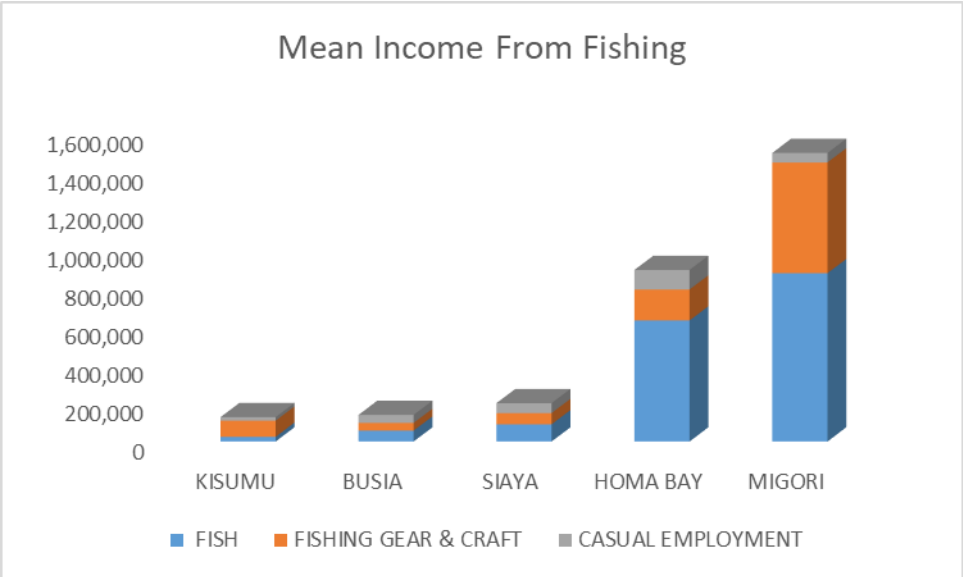

Figure 2. **Mean Income from Fishing**

Income from Crop Farming Related activities

The farming related activities that were considered included rain fed farming, irrigation farming, sale of crops (tubers), sale of fruits and vegetables and casual employment in farming activities. The mean income from farming was highest in Homa Bay (Kshs. 615,424) followed by Migori. A summary of this is given by figure 3.

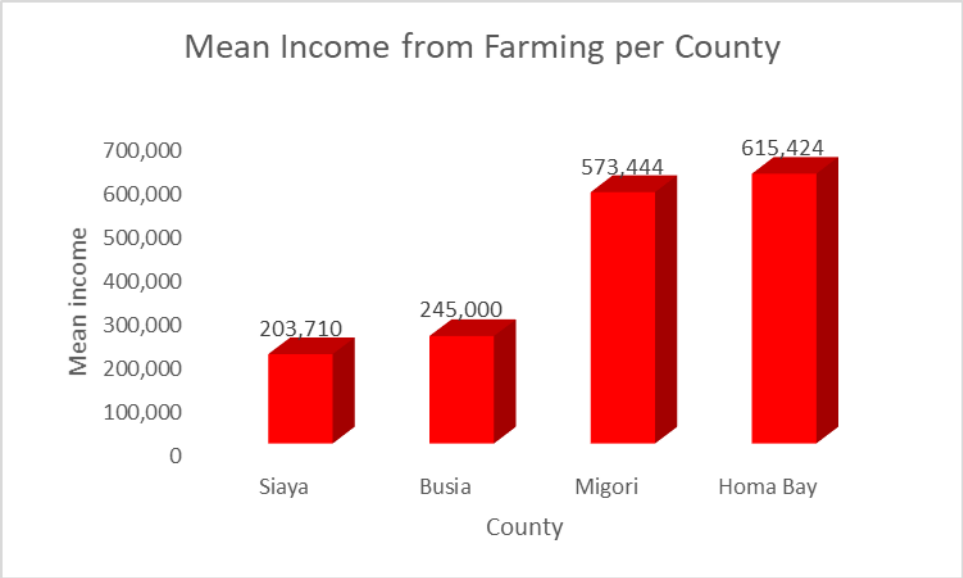

Figure 3. **Mean Income from Farming**

The bulk of the mean income came from sale of fruits and vegetables (Kshs. 221,016) and income from produce of irrigation farming (Kshs. 219,000) as shown by figure 4.4.

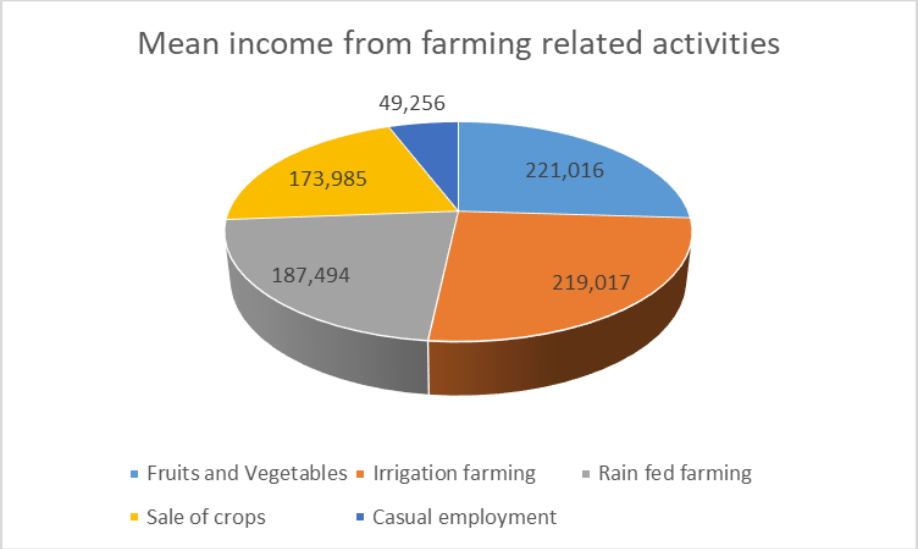

Figure 4. **Mean income from farming related activities**

Table 2
Annual Income from Crop Farming Related Activities (Kshs)

County		RainfallFarming	Irrigation Farming	Sale of Crops (Tubers)	Fruits and Vegetables	Casual Employment in Farming	Farming Total
Busia	Mean	211,111		125,000		50,000	245,000
	Total	1,900,000		500,000		50,000	2,450,000
Homa Bay	Mean	240,128	226,708	222,256	203,979	48,750	615,424
	Total	11,286,000	10,882,000	8,668,000	9,587,000	195,000	40,618,000
Migori	Mean	82,000	228,750	113,333	406,667		573,444
	Total	246,000	915,000	340,000	3,660,000		5,161,000
Siaya	Mean	102,857	160,714	98,750	47,000	50,000	203,710
	Total	2,880,000	1,125,000	1,975,000	235,000	100,000	6,315,000
Grand Total	Mean	187,494	219,017	173,985	221,016	49,286	470,207
	Total	16,312,000	12,922,000	11,483,000	13,482,000	345,000	54,544,000

Migori County had the highest mean income from sale of fruits and vegetables (Kshs. 406,667) followed by Homa Bay County.

Mean Annual Income from Livestock Farming Related activities

The main sources of income under this were sales of livestock and sales of livestock products. Siaya County had the highest mean income of Kshs. 252,889 followed by Homa Bay with a mean income of Kshs. 130,194. The mean income per county from sale of livestock was 123,000 while the mean income per county from the sale of livestock products was Kshs. 77,969. Table 3 presents a summary of the mean income per county by related activity.

Table 3
Mean Annual Income from Livestock Farming Related Activities (Kshs)

County		Sales of Livestock	Sales of Livestock Products	Total
Busia	Mean	150,000	61,667	161,667
	Total	300,000	185,000	485,000
Homa Bay	Mean	74,412	102,714	130,194

	Total	2,530,000	2,157,000	4,687,000
Migori	Mean	62,000	13,500	71,000
	Total	186,000	27,000	213,000
Siaya	Mean	716,667	21,000	252,889
	Total	2,150,000	126,000	2,276,000
Grand Total	Mean	123,000	77,969	150,216
	Total	5,166,000	2,495,000	7,661,000

Mean Income from Other Activities.

There were other non-fishing and non-farming activities that were considered in the study. These included sand harvesting, petty trade, business establishments, casual employments and other activities around the lake.

Sand harvesting was the highest income earner with a mean income of Kshs. 210,111. Migori had the highest mean in sand harvesting of Kshs. 441,429 per year. Casual employment along the lake was also another source of income with mean wages of Kshs. 167, 000. Table 4 summarizes these results.

Table 4
Annual Income from Other (Non-Fishing & Non-Farming Related) Activities (Kshs)

County		Sand Harvesting	Petty Trade	Business (not fisheries and agriculture)	Wages last year (Kshs)	Other activities taking place around the Lake Victoria waters	Total
Busia	Mean	80,000					80,000
	Total	80,000					80,000
Homa Bay	Mean	95,800	106,000	210,889	217,000	58,429	207,563
	Total	479,000	318,000	1,898,000	217,000	409,000	3,321,000
Kisumu	Mean	13,500	18,500	27,144		29,000	39,082
	Total	27,000	166,500	434,300		232,000	859,800
Migori	Mean	441,429	13,667	182,857	35,600	84,000	333,933
	Total	3,090,000	41,000	1,280,000	178,000	420,000	5,009,000
Siaya	Mean	35,333	50,000	126,667	369,333	28,500	231,375
	Total	106,000	200,000	380,000	1,108,000	57,000	1,851,000
Total	Mean	210,111	38,184	114,066	167,000	50,818	179,368
	Total	3,782,000	725,500	3,992,300	1,503,000	1,118,000	11,120,800

Total Economic Value from the resources of Lake Victoria

The total economic value from the resources of the Lake was derived from Fishing activities, crop farming, Livestock farming and other activities (non-fishing and non-farming related activities). The main sources of income (mean) from the lake were identified as crop farming (Kshs. 470,207) and fishing (Kshs. 400,937). Figure 5 presents the summary of mean income per activity.

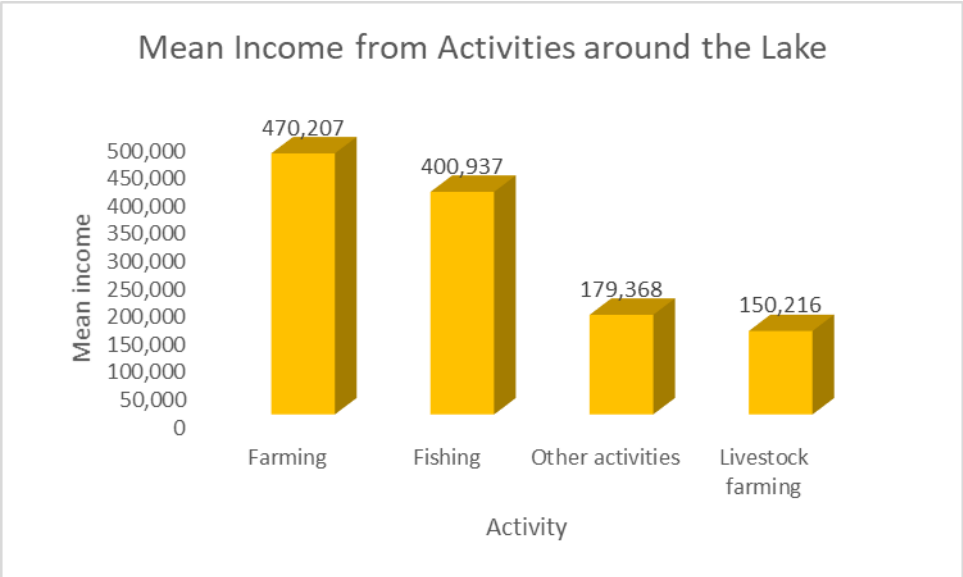

***Figure 5.*Mean Income Per Activity**

Table 5
Total Economic Value Derived from The Water Resources of The Lake Victoria

County		Fishing Total	Crop Farming	Livestock Farming	Other Activities	Total Income
Busia	Mean	77,857	245,000	161,667	80,000	209,411
	Total	545,000	2,450,000	485,000	80,000	3,560,000
Homa Bay	Mean	630,992	615,424	130,194	207,563	745,606
	Total	70,671,100	40,618,000	4,687,000	3,321,000	119,297,100
Kisumu	Mean	34,737			39,082	47,992
	Total	1,875,800			859,800	2,735,600
Migori	Mean	867,333	573,444	71,000	333,933	719,170
	Total	23,418,000	5,161,000	213,000	5,009,000	33,801,000
Siaya	Mean	92,966	203,710	252,889	231,375	217,691
	Total	4,927,200	6,315,000	2,276,000	1,851,000	15,369,200
Total	Mean	400,937	470,207	150,216	179,368	492,289
	Total	101,437,100	54,544,000	7,661,000	11,120,800	174,762,900

From Table 5it can be concluded that the estimate of the mean annual income from the lake is kshs. 492,289.

Figure 6 presents a comparison of the mean income per county per activity.

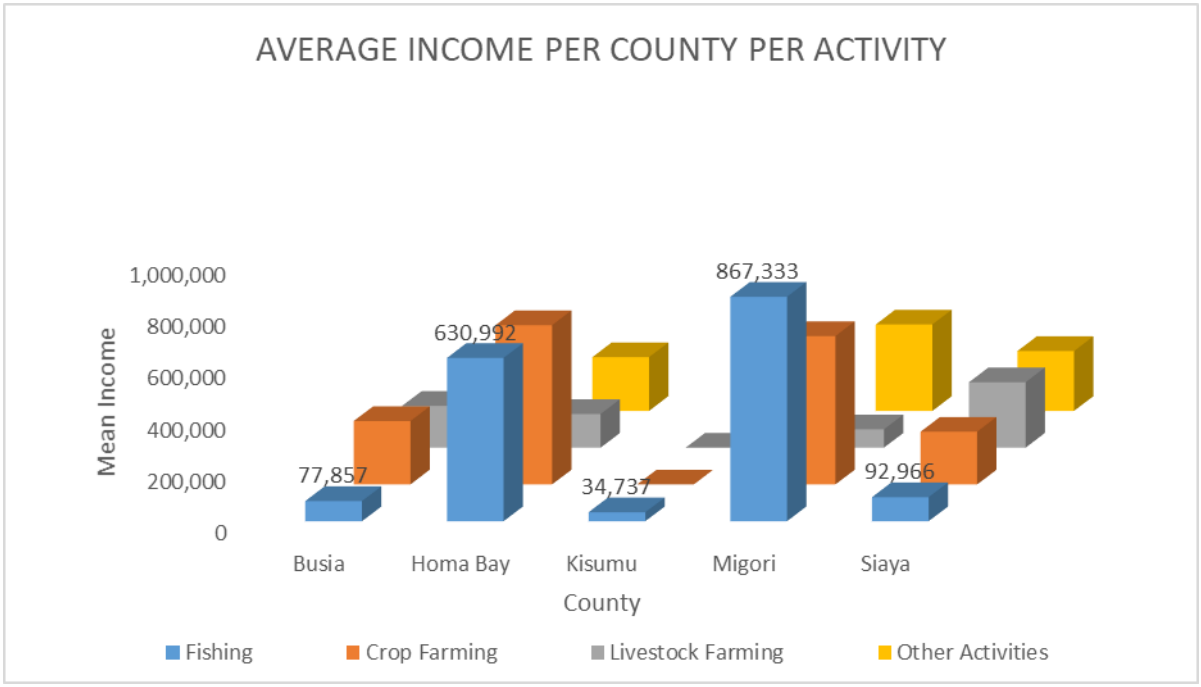

***Figure 6.*Mean Income Per County Per Activity**

Homa Bay County and Migori County are more economically viable compared to other Counties as displayed by figure 7.

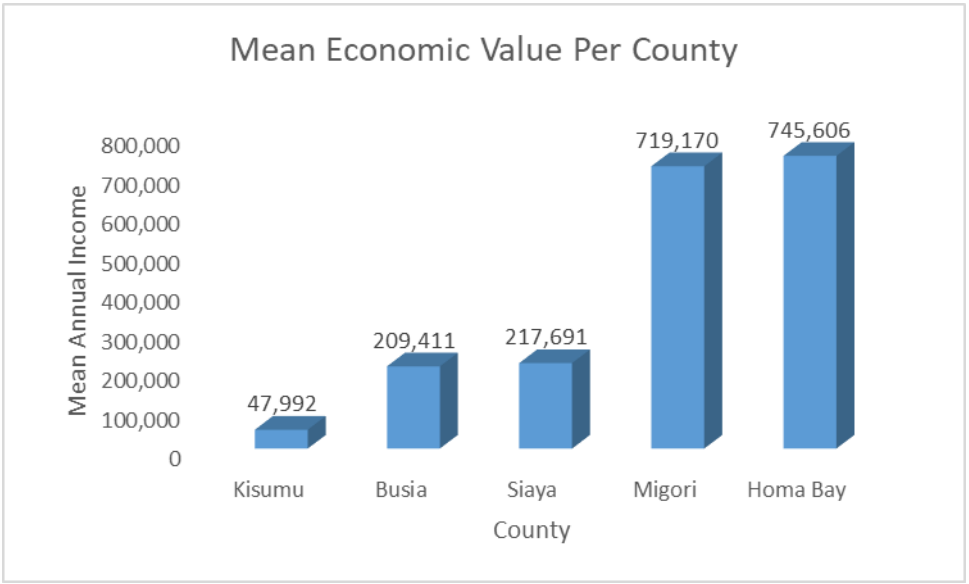

***Figure 7.* Economic Value per County**

In determining if there is exists a significant difference in mean income per county, analysis of variance was done (ANOVA). The null hypothesis tested was setbe no mean difference exists in the incomes across the counties. The null hypothesis is rejected wherever the p value of the test statistics is less than 0.05. The results are presented by Table 6.

Table 6
ANOVA Table

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	31,292,260,572,782	4	7,823,065,143,195	17.357	.000
Within Groups	157,749,878,630,710	350	450713938944.887		
Total	189,042,139,203,492	354			

Results in Table 6 shows that there is at least a significant mean difference in mean income between two counties. To determine which counties have significant mean difference in income a post ANOVA analysis was done using least squares difference (LSD). The results obtained are given by Table 7.

Table 7
Post ANOVA Analysis using LSD

(I) County Origin	(J) County Origin	Mean Difference (I-J)	Std. Error	Sig.
Busia	Homa Bay	-536,195*	171,258	.002
	Kisumu	161,418	185,525	.385
	Migori	-509,758*	190,005	.008
	Siaya	1,719	180,563	.992
Homa Bay	Busia	536,195*	171,258	.002
	Kisumu	697,613*	103,557	.000
	Migori	26,436	111,385	.813
	Siaya	537,914*	94,380	.000
Kisumu	Busia	-161,418	185,525	.385
	Homa Bay	-697,613*	103,557	.000
	Migori	-671,177*	132,275	.000
	Siaya	-159,698	118,313	.178
Migori	Busia	509,758*	190,005	.008
	Homa Bay	-26,436	111,385	.813
	Kisumu	671,177*	132,275	.000
	Siaya	511,478*	125,221	.000
Siaya	Busia	-1,719	180,563	.992
	Homa Bay	-537,914*	94,380	.000
	Kisumu	159,698	118,313	.178
	Migori	-511,478*	125,221	.000

Results from Table 7 shows that there is significant mean difference in mean income between Busia and Migori, Busia and Homa Bay, Homa Bay and Kisumu, Homa Bay and Siaya, Migori and Siaya, and Migori and Kisumu. However, there is no significant mean differences between Homa Bay and Migori and among Kisumu, Siaya and Busia. Households in Migori and Homa Bay are earning a higher mean income compared to their counter parts in Kisumu, Siaya and Busia.

IV. Conclusion

From this research it can be concluded that there are significant differences in mean income per household. Mean income per household resulting from the activities around the lake is higher in Homa Bay and Migori counties compared to Kisumu, Siaya and Busia. The results showed that the people of Homa Bay and Migoricounties have exploited the resources of the lake more than their counterparts from Kisumu, Siaya and Busia.

V. Recommendation

This study recommends that the residents of Busia, Siaya and Kisumu counties should be sensitized on the importance of exploiting the resources around the lake to the maximum. The research further recommends that other scholars should carry out a study to determine reasons behind the disparity.

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